A Slice of the Future Served on a Terra Cotta Plate

If you can drag yourself out of your warm bed two days after the April or May full moon in Hawaii, make your way to the nearest coral reef and jump into the chilly morning ocean water, your efforts may be rewarded with a natural show unlike any other. As you peer through the clear water, colonies of the coral *Pocillopora meandrina* will begin to emit a smoky substance, clouding the water around you with millions of sperm and eggs. This process is called broadcast spawning, and it is how most corals reproduce.

Approximately 80% of all corals are broadcast spawners (although *P. meandrina* is one of the few to spawn during the daytime). More rarely, corals brood their larvae. Whether coral larvae are brooded and then released or develop in the water column after broadcast spawning, they eventually must settle to the sea floor where they metamorphose into coral polyps. Some of these polyps will successfully undergo asexual division, and if they withstand predation and other stressors, will eventually recruit into the community of adult coral colonies with which we are familiar.

In Hawaii, sexual reproduction in most corals occurs in the spring and summer months, and PACN I&M scientists are there to study the process. As part of a larger effort to monitor the health of coral reefs in the Pacific over time, we want to understand when, where, and how many coral larvae settle on the reefs in national park waters.

At Kalaupapa National Historical Park, we study coral settlement by providing coral larvae an artificial substrate on which they can settle. In April, before the peak spawning period, three terra cotta tile arrays are deployed at each of fifteen locations throughout the park's marine waters. Five months later, after most spawning has ceased, the arrays are collected, and any coral polyps settled on the tiles are counted under a microscope. We have studied settlement for the past five years, and corals from the genera *Porites*, *Pocillopora*, and *Montipora* are the most common species observed. The number of settlers has been fairly consistent over time, but a large spike in *Montipora* settlers was observed in 2008. Continued monitoring may help us understand what causes these periodic spikes in settlement.

Monitoring coral settlement is important because without successful sexual reproduction, settlement, and recruitment, coral reefs cannot persist over the long-term. The processes involved in sexual reproduction are extremely sensitive, and threatened by stressors like climate change and ocean acidification. So while adult populations may appear healthy, the persistence of these populations may still be at risk. For example, with the coral *Acropora palmata*, elevated seawater temperatures have been associated with larval developmental abnormalities and decreased settlement rates. In the same species, ocean acidification, caused by increased atmospheric carbon dioxide levels, has been found to reduce fertilization success and larval settlement.

With the elevated atmospheric carbon dioxide levels predicted for the middle of this century, settlement success for this species is predicted to be reduced by more than 50%. Thus, in the coming years, coral reefs face even greater challenges for survival.

Monitoring coral settlement rates in our national parks, in addition to other monitoring activities, will help us keep track of the health of our reefs, and will allow us to make the educated decisions to protect and preserve these important ecosystems.

—K. Tice, NPS
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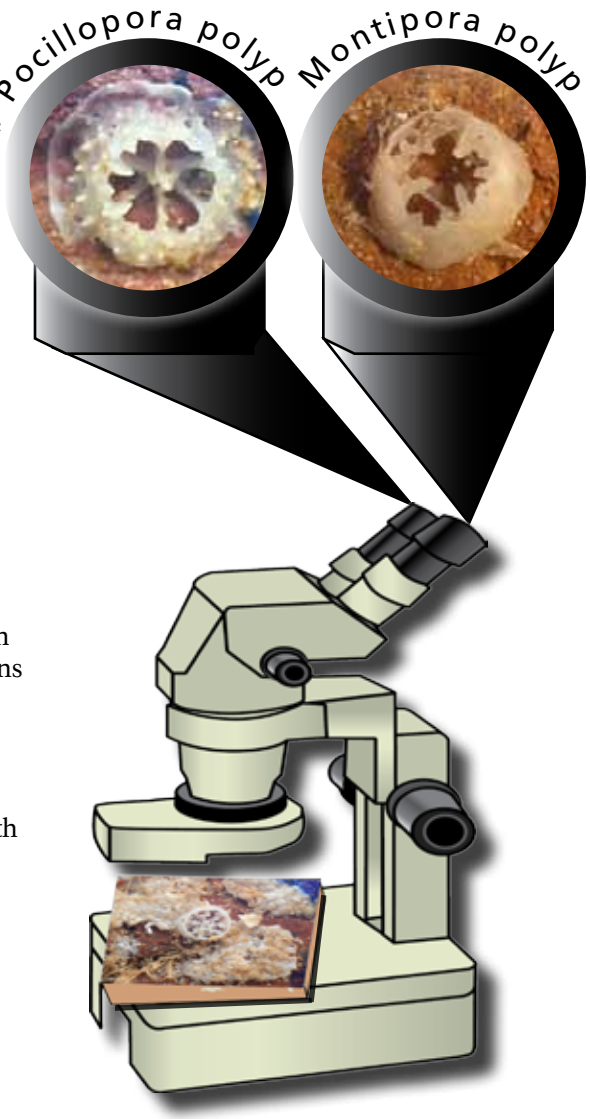
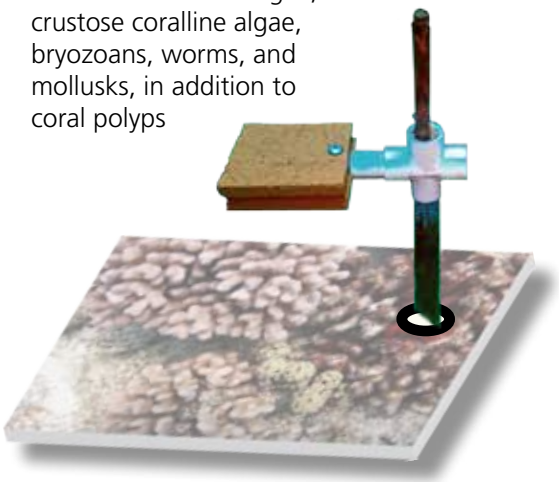


At the end of the five month deployment, the terra cotta tile is covered with algae, crustose coralline algae, bryozoans, worms, and mollusks, in addition to coral polyps



Coral settlement tile array